RESEARCH DEPARTMENT

V.H.F. SOUND BROADCASTING: MUTUAL INTERFERENCE BETWEEN TRANSMISSIONS WITH 100 kc/s CHANNEL SEPARATION RADIATING EITHER THE SAME OR DIFFERENT PROGRAMMES

Report No. G-082

(1962/10)

THE BRITISH BROADCASTING CORPORATION
ENGINEERING DIVISION

RESEARCH DEPARTMENT

V.H.F. SOUND BROADCASTING: MUTUAL INTERFERENCE BETWEEN TRANSMISSIONS WITH 100 kc/s CHANNEL SEPARATION RADIATING EITHER THE SAME OR DIFFERENT PROGRAMMES

Report No. G-082

(1962/10)

W Proctor Wilson

J.G. Spencer

(W. Proctor Wilson)

This Report is the property of the British Broadcasting Corporation and may not be reproduced in any form without the written permission of the Corporation.

Report No. G-082

V.H.F. SOUND BROADCASTING: MUTUAL INTERFERENCE BETWEEN TRANSMISSIONS WITH 100 kc/s CHANNEL SEPARATION RADIATING EITHER THE SAME OR DIFFERENT PROGRAMMES

Section	Title	Page
	SUMMARY	1
1	INTRODUCTION	1
2	EXPERIMENTAL INVESTIGATION	1
	2.1. Test Conditions	1
	2.2. Test Procedure	2
	2.3. Test Results	2
3	DISCUSSION OF RESULTS	4
4	CONCLUSIONS	4
5	REFERENCE	4

April 1962

Report No. G-082

(1962/10)

V.H.F. SOUND BROADCASTING: MUTUAL INTERFERENCE BETWEEN TRANSMISSIONS WITH 100 kc/s CHANNEL SEPARATION RADIATING EITHER THE SAME OR DIFFERENT PROGRAMMES

SUMMARY

Subjective tests have been carried out, using four recent models of domestic a.m./f.m. sound receivers, to determine the permissible ratio of wanted- to unwanted-carrier levels when an interfering f.m. transmission is spaced by 100 kc/s from a wanted f.m. transmission and is broadcasting either the same or a different programme.

Taking the average of the results for all receivers, the ratio of wanted-to unwanted-carrier levels for "perceptible" interference was 3·5 dB for different-programme modulation on the two transmitters and 0 dB for common-programme modulation, and a relaxation of the standard protection ratio of 12 dB appears permissible in the latter case. The average change of carrier ratio required to cause a change of one grade in the subjective rating of the interference was 1·5 dB.

1. INTRODUCTION

The new Band II frequencies made available to the U.K. for f.m. broadcasting at the 1961 Stockholm Frequency-Planning Conference include some allocations with 100 kc/s spacing. In order to make the best use of these frequencies it is important to know whether the degree of protection required against mutual interference between services employing frequencies 100 kc/s apart can be relaxed when the same programme is being broadcast on the two frequencies, since the standard protection ratio assumes different programmes. Previous work[1] has shown that a useful relaxation is possible in the case of 200 kc/s spacing. Subjective assessments were therefore made in the laboratory of the interference effects when two modulated signals with 100 kc/s carrier-frequency separation are fed into typical domestic receivers. The tests were arranged primarily to determine the ratios of carrier levels that give the same degree of interference under common-programme and different-programme conditions.

2. EXPERIMENTAL INVESTIGATION

2.1. Test Conditions

Two f.m. signal generators were used to represent the wanted and interfering transmitters and their outputs were fed to the receiver under test. The signal level of the wanted transmission was maintained constant at 1 mV (open-circuit voltage from a 75Ω source) and the interfering signal level varied to produce the desired wanted-to-unwanted signal ratio.

Three tape recordings of different types of programme were used to modulate the signal generators:

(i) News reading
(ii) Piano solo
(iii) Light orchestral music.

The depth of modulation and pre-emphasis time constant were in accordance with standard B.B.C. practice.

A network giving a delay of 1 ms was inserted in the modulation chain to the unwanted signal generator to avoid undue correlation between the modulating signals when operating with common programme, so giving a reasonable simulation of the conditions at the receiver in typical practical situations when interference might occur.

2.2. Test Procedure

The observer was first asked to tune the receiver with only the wanted signal present. (This procedure was adopted since it was desired to simulate a condition where the interference occurred occasionally; it was thus essential that the listener's normal tuning point should not be affected by the presence of an interfering signal.) The interfering signal was then switched on at a frequency 100 kc/s higher than the wanted signal and its level adjusted to give, in turn, specified grades of interference as assessed by the observer. The following grades were used:

JP (just perceptible)	The interference was just perceptible, with careful listening, in the quiet passages of the wanted programme.
P (perceptible)	The interference was perceptible in the quiet passages of the wanted programme without careful listening.
SD (slightly disturbing)	The interference was slightly disturbing when listening to the wanted programme.
D (disturbing)	The interference was disturbing.

This procedure was repeated with the interfering signal 100 kc/s lower in frequency than the wanted signal and with various permutations of the three types of programme as wanted- and unwanted-signal modulation. In the assessment of the grade of interference produced, the observers took note of both interference accompanying the programme and distortion of the wanted programme itself. For convenience, however, the term "interference" is used throughout this report to cover all effects of the interfering signal.

2.3. Test Results

All the test results quoted are the averages for two critical observers.

Table 1 shows the wanted- to unwanted-signal ratio required to give "perceptible" interference with various combinations of wanted and unwanted programme. The results for the two cases where the interfering transmission is 100 kc/s higher and 100 kc/s lower in frequency than the wanted transmission have been averaged.

TABLE 1

Receiver	Wanted- to unwanted-signal ratio (dB) for "perceptible" interference					
	Wanted:	News	Piano	Light Orch.	News	Piano
	Unwanted:	News	Piano	Light Orch.	Light Orch.	Light Orch.
Murphy A252		0	0	0·5	0·5	0
Ekco A239		-0·5	0·5	-0·5	6·0	4·0
Bush VHF71		-1·5	0	-0·5	6·0	4·0
Ferguson 382U		-0·5	0·5	1·0	4·5	2·5
Average		0			3·5	

Table 2 also shows the wanted-to-unwanted signal ratio for "perceptible" interference but in this case the figures for +100 kc/s and -100 kc/s offset are shown separately while the two cases of different-programme and the three cases of common-programme operation are averaged.

TABLE 2

Receiver	Wanted- to unwanted-signal ratio (dB) for "perceptible" interference			
	Same Programme		Different programme	
	+100 kc/s	-100 kc/s	+100 kc/s	-100 kc/s
Murphy A252	-1·0	2·0	-0·5	1·5
Ekco A239	-4·5	4·0	3·5	6·5
Bush VHF71	2·5	-4·0	6·5	3·0
Ferguson 382U	0·5	0	3·5	3·5

Table 3 shows the signal ratios required to produce the four grades of interference; the figures for ± 100 kc/s offset and for common and different programme respectively are averaged.

TABLE 3

Receiver	Wanted- to unwanted-signal ratio (dB) for stated grade of interference							
	Same programme				Different programme			
	JP	P	SD	D	JP	P	SD	D
Murphy A252	0·5	0·5	-0·5	-1·5	1·5	0·5	-0·5	-1·0
Ekco A239	1·0	0	-2·0	-3·5	6·5	5·0	4·0	2·5
Bush VHF71	1·0	-1·0	-3·0	-5·0	6·5	5·0	3·0	1·0
Ferguson 382U	2·0	0·5	-1·5	-3·0	6·0	3·5	1·5	0
Average	1·0	0	-2·0	-3·5	5·0	3·5	2·0	0·5

3. DISCUSSION OF RESULTS

Table 1 shows that the average reduction in wanted-to-unwanted signal ratio permitted when changing from different- to common-programme working is 3·5 dB. Within these two sub-divisions, however, the type of programme has little influence on the protection ratio required.

The average shown in Table 1 should, however, be regarded with caution. Table 2 shows that, with two of the receivers tested, the asymmetry of the results for positive and negative frequency offsets increased with common-programme interference; the asymmetry is such that, at the frequency to which the receiver is most susceptible to interference, the improvement obtained by changing to common programme was less. On the other hand, the sets with the poorer interference rejecting properties tended to show greater average improvements on changing from different- to common-programme working.

4. CONCLUSIONS

Taking into account the considerations discussed in Section 3 above, together with the figures for the absolute values of carrier ratio giving "perceptible" interference, it appears permissible to reduce the C.C.I.R. value for the protection ratio required to give satisfactory reception for 99% of the time, for carriers spaced 100 kc/s, from 12 dB to 6 dB in cases where the same programme will always be radiated. This conclusion applies to monophonic broadcasting only.

5. REFERENCE

1. "V.H.F. Frequency Modulation Broadcasting: Adjacent-Channel Interference for Common and Different Programmes", Research Department Technical Memorandum No. G-1023, March 1957.

BRH

Printed by B.B.C. Research Department, Kingswood Warren, Tadworth, Surrey